Research Document: Mesh and Structure Generation

How does one approach the generation of meshes?

There are three different commonly used techniques when generating meshes from scratch. These are:

* + **Fractal generation**A Recursive algorithm that uses symmetry to keep making smaller and smaller versions of itself. Commonly used for making trees and decorative patterns.(Kelly & McCabe, 2006)
  + **L-system**

A type of algorithm that allows itself to rewrite part of its outputs to construct more complex objects. This allows it to be able to break free from the symmetry aspect of fractals and grants the ability to make more realistic plants and various other things found in nature. (Kelly & McCabe, 2006)

* + **Perlin Noise**A method developed to generate 2D grids of semi-randomized values which are then interpolated into coherent noise. Several layers of this noise is then compressed together, each with their own unique ratio to create a more natural looking texture. This is frequently used to generate landmasses but can be used for texturing any many other things too. (Kelly & McCabe, 2006)

What type of tools could be used?

Since our engine of choice is the unity engine. It is important to know unity

editor script for the purpose of creating custom tools that allow the designers to work on setting the parameters.

* + **Marching squares/cubes**First the area/volume is split into a square/cube grid. Then a premade noise map is laid over it. This then based on what the connecting pixels have places certain models at certain positions. Filling the area until it’s finished. (Bonsma, 2019)
  + **Wave function collapse**

Makes a grid with all the modules in every grid position. Then randomly choosing 1 module in one of the grid positions. This grid has a set of rules of modules that can be adjacent to it. Meaning it will start deleting modules next to it that don’t fit. Those modules will start doing the same. Eventually creating a chain reaction that eventually solves it. (Breda University of Applied Sciences, 2018)

What are widely used ways of optimizing rendering times?

Many times, the most used concept is just trying to render less stuff.  
 This can be done with:

* **Occlusion** **culling**  
  The act of not rendering everything that is outside of the FOV of the camera. This can also include not rendering the backside of objects that you are looking at. (Bonsma, 2019)
* **Level of Detail**

Many times, there are multiple versions of the same model made with varying detail levels. Depending on the distance away from that object it will then load a version of that model so that it looks detailed enough for that distance, but it must load less detail. (Bonsma, 2019)

# References

Bonsma, P. (2019, September 30). *PROCEDURAL ART Lecture 2 - Modular Meshes.* Retrieved from leren.saxion.nl: https://leren.saxion.nl/bbcswebdav/pid-2545343-dt-content-rid-77021934\_4/institution/ACT/CMGT/2019-2020/Y1/T1/procedural\_art/Procedural-Art-ModularMeshes.pdf

Breda University of Applied Sciences. (2018, July 11). *EPC2018 - Oskar Stalberg - Wave Function Collapse in Bad North*. Retrieved from Youtube: https://www.youtube.com/watch?v=0bcZb-SsnrA

Kelly, G., & McCabe, H. (2006, November 27th). *A Survey of Procedural Techniques for City Generation.* Retrieved from Citygen: http://www.citygen.net/files/Procedural\_City\_Generation\_Survey.pdf